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APPLICABILITY OF FINANCE THEORY TO PUBLIC

UTILITY RATE CASES

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Stewart C. Myers

September 1970

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APPLICABILITY OF FINANCE THEORY TO PUBLIC

UTILITY RATE CASES

^{by}
Stewart C. Myers

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APPLICABILITY OF FINANCE THEORY TO
PUBLIC UTILITY RATE CASES

Stewart C. Myers*

I. INTRODUCTION

There is little argument in practical circles about the broad purpose of regulating public utilities' rates of return. The accepted principle is:

The return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise so as to maintain its credit and to attract capital.**

Finance (the study of investments, capital markets and particularly corporate financial management) seems directly relevant to regulatory agencies attempting to judge what rate of return the law calls for. It is relevant. However, the application of finance theory in the regulatory field is not trivial or obvious.

The difficulties involved in transferring finance theory to regulatory problems is attested to by the sharp controversies generated by economists who have ventured into rate proceedings. Disagreements have

* Associate Professor of Finance, Sloan School of Management, Massachusetts Institute of Technology. An earlier draft of this paper was presented at the conference on "Problems of Regulation and Public Utilities" held at Dartmouth College in September, 1970. I am grateful to seminar participants for helpful criticism. Particular thanks are also due to Willard Carleton and David Schwartz for their detailed comments.

** This is from the Supreme Court decision on Federal Power Commission et. al. vs. Hope Natural Gas Company (1949). 320 U.S. at 603.

arisen not only between economists and the usual participants in these proceedings, but also between the economists themselves. Thus the problem is not simply explaining the theory to the regulators. It has not been clear how the theory should be applied.

The purpose of this paper is to:

1. Review current regulatory procedures and the controversies associated with recent attempts to apply financial theory;
2. Indicate which of the controversies are real and which ones are misunderstandings;
3. Summarize the state of the art in this field and the ways in which finance theory is applicable to regulatory problems;
4. Suggest new approaches to regulation, all consistent with finance theory, but which differ widely in other respects, such as the allocation of risk-bearing among consumers and investors.

Three important assumptions are maintained throughout the paper:

1. That utilities' overall rates of return should be an object, although not necessarily a direct instrument, of regulation.
2. Other objects of regulation, such as the level and quality of utilities' services, are not considered either.
3. Problems involving inflation are sidestepped. These include topics such as the divergence of original and replacement cost of assets, or the distinction between real and nominal rates of return.

II. REVIEW AND EVALUATION OF CURRENT PROCEDURES

The first step is to review current procedures. I will do this as briefly as possible.

A utility's prices are set so that the utility covers its costs, including taxes and depreciation, plus a certain return on investment. The return on investment is obtained by multiplying the "rate base" by an allowed percentage return. The rate base is essentially the book value of the utility's capital investment.*

For example, suppose Utility X has a rate base of \$100 million. During the test period chosen as a basis for regulation, it produced widgets at a rate of 1 billion per year. Costs were \$50 million per year, including depreciation and taxes. Suppose the allowed rate of return is set at ten percent overall, after taxes. Then the (average) price of widgets is set as follows.

$$\begin{aligned} \text{Price per widget} &= \frac{\text{Revenue requirements}}{\text{No. of widgets}} \\ &= \frac{50,000,000 + .10(100,000,000)}{10^9} = \$.06 \end{aligned}$$

* Reproduction cost, or "fair value" rate bases, are not considered in this paper.

** Costs would be adjusted to cover income taxes associated with a ten percent return.

TABLE 1

Pacific Gas Transmission Co.

-- Allowed Overall Rate of Return

<u>Capital Source</u>	<u>Per Cent of Capitalization</u>	<u>Per Cent Cost</u>	<u>Weighted Cost</u>
Debt	79.66	6.13	4.88
Equity	20.34	11.64	2.37
<hr/>			
Total			<u><u>7.25</u></u>

Source: Federal Power Commission Opinion No. 579 (Pacific Gas Transmission Co., Docket RP70-4), June 5, 1970, p. 15.

Thus widgets are sold for \$.06 each until the next regulatory proceeding. This procedure allows the actual return earned to be more or less than ten per cent, depending on realized cost and revenues.

The overall return is computed in the same fashion as a weighted average cost of capital, but with important differences. Table 1 shows the computation of the overall rate of return allowed Pacific Gas Transmission Company in a Federal Power Commission decision announced on June 5, 1970. The procedure for computing the overall return, 7.25 per cent, is clear from the table, but the table does not show where such numbers typically come from.*

1. The figures listed under "percent of capitalization" refer to the respective percentages of debt and equity listed on the company's books at the time the rate proceeding was initiated. They are not the market value weights usually called for by theory of corporate finance. Neither do they necessarily refer to the proportions of debt and equity to be employed in future financing.
2. The percentage cost of debt is the total current interest commitments of the firm divided by the book value of currently outstanding debt. The company's current borrowing rate can be much higher or lower than the "em-

*

What follows is not a direct synopsis of the Pacific Gas Transmission Case, but a general sketch of regulatory procedures.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It is divided into two main sections: the first section deals with the general situation and the second section deals with the progress of the work.

2. The second part of the report deals with the results of the work during the year. It is divided into two main sections: the first section deals with the results of the work in the field and the second section deals with the results of the work in the laboratory.

3. The third part of the report deals with the conclusions of the work during the year. It is divided into two main sections: the first section deals with the conclusions of the work in the field and the second section deals with the conclusions of the work in the laboratory.

4. The fourth part of the report deals with the recommendations of the work during the year. It is divided into two main sections: the first section deals with the recommendations of the work in the field and the second section deals with the recommendations of the work in the laboratory.

5. The fifth part of the report deals with the summary of the work during the year. It is divided into two main sections: the first section deals with the summary of the work in the field and the second section deals with the summary of the work in the laboratory.

bedded" debt cost shown.

3. The percentage cost of equity shown is a figure arrived at by judgment. To the extent that it can be explicitly stated the main basis for this judgment appears to be the "comparable earnings" approach.* That is, the cost of equity is set in the range of recent accounting rates of return reported by other firms of "comparable" risk. In practice, one finds that the only firms of strictly comparable risk are other utilities, whose reported rates of return reflect past regulatory decisions. So, additional evidence on rates of return in non-regulated industries is normally introduced, with the understanding that utilities need not earn as much as non-regulated companies because of differences in business risk. To repeat, the final determination is based on judgmental assessment of these and other data.**

Although there are opportunities for disagreement at each of these three steps, most argument is centered on the return to equity. The use of embedded debt costs and book value weights has not been seriously questioned. I will set these items aside until later in the paper, however, and concentrate on the equity cost. It is convenient to assume that utilities are all-equity financed. This assumption is relaxed in the penultimate section of the paper.

* At least this is the major alternative to use of finance theory.

** It is worth mentioning, in addition, that 7.25 percent is not necessarily an unbiased estimate of what Pacific Gas Transmission Company will actually earn. There have been a variety of trends in costs and revenues not taken account of in the regulatory process.

The Comparable Earnings Standard

The comparable earnings approach can be justified in several ways.* The first is that it conforms directly to the law's prescription that returns should "be commensurate with returns on investments in other enterprises having corresponding risks." This follows directly if we assume that "return" is defined as the reported accounting rate of return of other firms -- not, for example, the return that an investor anticipates on other firms' stock.

If we define "return" to be dividends and capital gains stemming from purchase of utilities' common stock, then the comparable earnings rule can be supported as a proxy or rule of thumb. The assumption is that a firm which earns a satisfactory accounting rate of return will also yield satisfactory returns to its shareholders.

The comparable earnings approach can be supported by introducing a notion of opportunity cost -- in this context, that a utility should be allowed to earn what it would have earned had its capital been invested in another industry of comparable risk.**

To summarize, those who advocate a comparable earnings standard read the Hope decision in a particular way, namely:

The return to the equity owner should be commensurate to recent average realized book returns on past investments made by other enterprises having corresponding risks.

* The most complete exposition and defense of the method is Harold Leventhal, "Vitality of the Comparable Earnings Standard for Regulation of Utilities in a Growth Economy," Yale Law Journal, Vol. 74 (May 1965), 989-1010.

** See, for example, Walter A. Morton, "Guides to a Fair Rate of Return," Public Utilities Fortnightly, Vol. 86 (July 2, 1970), 17-30.

Drawbacks of the Comparable Earnings Standard

The comparable earnings method clearly has a good deal of common sense appeal; nevertheless, at second glance it has such deficiencies that it should not be accepted without serious search for something better.

For example, the method does not rest easily on the concept of opportunity cost. Opportunity cost is a marginal and forward-looking concept. Thus, the opportunity cost of capital is usually defined as the marginal expected rate of return^{of funds}/invested in the best alternative use. However, observed accounting rates of return are ex post averages. (Granted, average and marginal returns are equal at equilibrium in perfectly competitive markets, but this is in an ex ante sense. No one argues that perfect competition requires equality of rates of return after the fact in an uncertain world. In any case, no attempt is made in regulatory proceedings to see whether the data examined really are marginal rates of return, and whether they stem from perfectly competitive situations.)

However, the major objection from the viewpoint of corporate finance theory is that the comparable earnings method ignores capital markets completely. This is serious because the utility investor is not directly interested in the ratio of accounting earnings to the book value of a company he invests in. He looks at anticipated dividends and capital gains relative to the stock price he has to pay. Thus it seems more relevant to interpret opportunity cost as the expected rate of return on securities with risks similar to the stock of the utility in question.

The comparable earnings method may still be advanced as a rule of thumb, with accounting rates of return taken as proxies for shareholders' opportunity costs. However, it is not a very good proxy. Suppose you are looking for a company with risk commensurate with Utility X. The likeliest candidates are all other utilities, whose reported accounting rates of return do not only reflect competitive forces, but past regulatory decisions to a significant degree. This leads, obviously, to an arbitrary standard. One is forced to look elsewhere, to un-regulated firms. However, there is no clear theory about how risk should be related to equilibrium differences in accounting rates of return (or even how risk should be defined if the accounting rate of return is the variable of interest). In contrast, the relationship of risk and return in capital markets is much better understood.* We also know that accounting rates of return are subject to serious measurement errors and biases, as is shown later in this paper.

To summarize, the difficulties with the comparable earnings standard are at very least sufficient to justify examination of alternatives. What does finance theory have to offer?

*Two good, recent surveys are J. Hirshleifer, Investment, Interest and Capital, (Englewood Cliffs: Prentice-Hall, 1970); William F. Sharpe, Portfolio Theory and Capital Markets (New York: McGraw-Hill, 1970).

III. THE COST OF CAPITAL CONCEPT

If a utility's allowed rate of return is to be "sufficient . . . to attract capital" and "commensurate with returns on investments in other enterprises having corresponding risk" then it has something in common with the cost of capital as that concept is used in corporate finance. But the cost of capital can stand for such a variety of things that it will be helpful to review the concept briefly.

To simplify matters, we will concentrate for the moment on a firm that is all-equity financed and which can ignore market imperfections such as transaction costs and taxes. The logic in developing a cost of capital (i.e., minimum acceptable expected rate of return, or "hurdle rate") for such a firm's investments goes as follows:

1. The firm is one of a class with similar risk characteristics -- call this class "j."
2. At any point in time there is a unique expected rate of return prevailing in capital markets for this degree of risk -- call it R_j .
3. The share price of the firm in question will adjust so that it offers an expected rate of return R_j to investors.
4. This rate, the shareholders' opportunity cost, should be the minimum acceptable expected rate of return on new investment, assuming the projects under consideration have risk characteristics similar to currently held assets.
5. If, on the other hand, the projects under consideration change the risk characteristics of the firm, then a different discount rate should be applied.

6. Suppose that the project under consideration has risk characteristics like firms of risk class k . In this case the appropriate opportunity cost is R_k , the going expected rate of return on firms in class k . This rate should be used to discount the project's cash flows.*

This sequence of logic is sufficient to find the appropriate discount rate for projects of any given risk level under the assumed ideal conditions of all-equity financing, and absolutely perfect markets. For such a firm, the basic problem is simply one of estimating the rates prevailing in the market for different levels of risk.

Actually, estimating R_j , R_k , etc. does not suffice for most firms' investment choices. It is, of course, a necessary step. But in the typical case the base rate, say R_j , must be adjusted for various tax effects, transaction costs, and the particular mix of debt and equity instruments used. It is also possible that the final decision about investment projects will be further affected by other corporate goals (e.g., social ones), interdependencies among projects, and so on.

To illustrate, consider the impact of transaction costs in raising capital. Let R , the cost of capital in the sense of shareholders' opportunity cost, be 12 percent. A project under consideration must be financed with a new stock issue, with transaction costs amounting to 10 percent of the net amount issued. The project offers a perpetual expected

*I have shown, that, in efficient markets, the hurdle rate for a project depends solely on its own risk characteristics, not on the risk characteristics of the firm's other assets. This is why no diversification motive is introduced here. See "Procedures for Capital Budgeting Under Uncertainty," Industrial Management Review, Vol. 9 (Spring 1968), 1-20.

cash flow of Z on an investment 100. Then Z must be high enough that the project's net present value is at least as large as the transaction cost:

$$\frac{Z}{.12} - 100 = .1(100)$$

$$Z = 12(1.1) = 13.20$$

Thus the hurdle rate for this project is 13.2 percent after adjustment for transaction costs.

Therefore, coming up with the cost of capital in the sense of a "hurdle rate" for practical evaluation of an investment opportunity requires the decisionmaker to face two distinct types of problems.

1. Problems of estimating shareholders' opportunity costs.
2. Problems of application -- that is, of adjusting a basic opportunity cost for complications encountered in any practical context.

Precisely the same distinction is critical in applying corporate finance theory to regulatory problems. We will deal with problems of estimation in the next section, and with problems of application in the section after that.

IV. ESTIMATING SHAREHOLDERS' OPPORTUNITY COSTS

The Available Evidence

In order to concentrate on problems of estimation I will continue to treat utilities as if they were all-equity financed. The term "cost of capital" will refer to shareholders' opportunity cost given the risk

characteristics of a utility's assets. Measurement of debt costs, their weighting with equity costs and other adjustments are discussed later in the paper.

The basic proposition underlying the cost of capital concept is that at any point in time securities are so priced that all securities of equivalent risk (i.e., all securities in a "risk class") offer the same expected rate of return. For a given utility the basic problem is to determine the expected rate of return for the class in which the stock falls.

There is no mechanical way to do this, but there are several types of evidence that should be examined before the ultimate judgment is made.

Interest rates. -- Interest rates on corporate bonds and other instruments can be readily observed to provide a floor. Changes in the basic level of interest rates normally correspond in direction to changes in the cost of equity capital.

Ex post rates of return to investors. -- Averaging of ex post rates of return (or better, of ex post risk premia, since interest rates vary over time) gives some indication of the relevant range in which expectation lie. These averages are most helpful to the extent that they cover a long period of time and many stocks; one cannot very well rely on five years of history for the utility in question as a guide to the investors' expectations for the future.

DCF approaches. -- The term "DCF" (discounted cash flow) refers to the fact that the value of an asset can be expressed as the present value of the stream of cash flows yielded by the asset over its entire life. For stock this means that price is the present value of the future

dividend stream $(D_1, D_2, \dots, D_t, \dots):^*$

$$P_{0j} = \sum_{t=1}^{\infty} \frac{D_{tj}}{(1+R_j)^t} \quad (1)$$

This does not mean that any one investor expects to realize the entire dividend stream from here to eternity. Demand for security j at $t=0$ is usually based on expectations of dividends and capital gains over a relatively short period, say one year. Thus

$$P_{0j} = \frac{D_{1j} + P_{1j}}{1+R_j} \quad (2)$$

We obtain Eq. (1) from (2) by substituting $(D_{2j} + P_{2j}) / (1 + R_j)$ for P_{1j} ; $(D_{3j} + P_{3j}) / (1 + R_j)$ for P_{2j} , and so on.

The so-called "DCF method" for estimating the cost of capital has been frequently relied upon in rate of return testimony based on

* Of course this is a simplified view. Not everyone has the same expectations about future returns. But for purposes of analysis I assume they do, or that it is permissible to speak of "the market's" expectations.

Also, I assume that the same discount rate R_j is applied to all future dividends. This is probably a reasonable simplification here. See, however, A. A. Robichek and S. C. Myers, "Conceptual Problems in the Use of Risk-Adjusted Discount Rates," Journal of Finance, XXI (December 1966), 727-30.

Finally, "dividends" must be broadly interpreted to include all cash flows from the firm to holders of the share in question. Conceivably, D_t might include return of capital or even direct repurchase of shares by the firm.

financial theory.* The idea is simple" to infer R_j from the observed price P_j and an estimate of what investors expect in the way of future dividends, D_1, D_2, \dots, D .**

In practice a number of simplification of Eq. (1) are employed in using the DCF method. Suppose for example, that the dividend stream is expected to grow indefinitely at some rate g which is less than R_j . Then Eq. (1) can be simplified to

$$P_{oj} = \frac{D_{1j}}{R_j - g} \quad (3)$$

$$R_j = D_{1j}/P_{oj} + g \quad (3a)$$

For utilities, for which a constant, moderate long-term trend in

* For a review, see Herman G. Roseman, "Measuring the Cost of Capital for Public Utilities," In American Bar Association, Public Utility Law, Annual Report Section, 1969. Some examples are: Testimony of Irwin Friend, American Telephone & Telegraph Company hearings, FCC Docket 16258; Testimony of Stewart C. Myers, Texas Eastern Transmission Company, FPC Docket RP69-13; Testimony of David A. Kosh, New England Telephone and Telegraph Company, Rhode Island Public Utilities Commission Docket 1024.

** Instead of projecting dividends to infinity, one can project dividends to some horizon period H and estimate P_{jH} , the expected price in $t=H$. Thus R_j is inferred from

$$P_{jo} = \sum_{t=1}^H \frac{D_{jt}}{(1+R_j)^t} + \frac{P_{jH}}{(1+R_j)^H} .$$

The price P_{jH} will depend on anticipated subsequent dividends, however.

earnings and dividends is often identifiable, Eq. (3a) often affords a reasonable rule of thumb for estimating R_j . The danger is that past growth trends in dividends or earnings per share are apt to be mechanically projected without asking whether any reasonable investor could believe such a projection.

Likewise, it is easy to assume without checking that expected future growth is constant. In the case of natural gas pipelines, for example, growth in the late 1960's was relatively rapid because gas is a relatively pollution-free fuel. However, further growth is at least temporarily constrained by limited supplies.

Fortunately, there is nothing in Eq. (1) that requires a single, perpetual growth rate. One can easily assume that different growth rates are anticipated for different future periods.*

In general, the DCF model -- either Eq. (3a) or some more complicated variant on Eq. (1) -- has to be fit to the case at hand. The point of the analysis is to answer the question "what would a rational, unbiased investor expect from a long-term investment in this stock at the prevailing price?" This rate of return is taken to be R_j on the assumption that the prevailing price is based on the opportunity cost R_j for securities in the same risk class.

* In the Texas Eastern Transmission Company case, (Federal Power Commission, Docket RP69-13, 1969), I used a simple structural model of the firm to project the dividend stream under different assumptions about short-term growth, long-term growth, and year-by-year profitability. The expected dividend stream and the final estimate of the cost of equity capital were based on these simulations.

Earnings-price ratios. -- Earnings-price ratios can be used to measure the cost of equity capital in some cases. The formulas

$$P_{oj} = \frac{EPS_1}{R_j} \quad (4)$$

$$R_j = \frac{EPS_1}{P_{oj}} \quad (4a)$$

are actually special cases of Eq. (1) if certain assumptions hold.

1. Suppose that earnings per share in any one year are "normal" long-run earnings of the firm's business and that all earnings are paid out as dividends. Then Eqs. (4) and (4a) are simply (3) and (3a) but with $g=0$.
2. Thus it is said that EPS/P_{oj} measures the cost of equity capital for "no-growth" firms. This is not strictly correct, however. Suppose a firm which falls initially into the no-growth category reinvests a portion of its earnings in projects which have on average a present value of exactly zero. (E.g., suppose the projects do not change the firm's risk class but offer an average expected rate of return exactly equal to the cost of equity capital*). Then the announcement of these

* The impact of a project on share price is the change in the present value of the dividend stream due to the project. (The project's investment and cash returns impinge directly on the dividend stream if the project is considered apart from any offsetting investment or financing transactions.) Thus

projects will make the firm no more or less attractive to investors. The firm's stock price will not change, nor will earnings per share. Therefore, R_j is still correctly measured.

If the projects are on average more than marginally desirable, however, the price will rise, earnings per share will remain constant, and thus the earnings-price ratio will underestimate R_j .

We see that growth in itself does not invalidate Eqs. (4) and (4a). What does invalidate the formulas is growth that is more or less than minimally profitable.

It is interesting that earnings-price ratios were widely used by regulatory agencies in the early post-war period. Now they have been effectively discredited. The apparent reason is that they are too low to be seriously regarded as good estimates of cost of equity capital. Although this is not recognized as such it is an admission that investors expect utilities to provide a return more than cost of equity capital on future investments.

Econometric models. -- One difficulty with the DCF approach is that it measures the expected rate of return common to all securities in a risk class by sampling one security: the stock of the utility being regulated. This is not necessarily improper. Utilities' future prospects are relatively predictable and well-understood, and the

Footnote continued from page 17 --

$$\Delta P = \sum_{t=1}^{\infty} \frac{\Delta D_t}{(1+R)^t}$$

$\Delta P = 0$ if the rate of return of the stream $\Delta D_1, \Delta D_2, \dots, \Delta D_t, \dots$, is R .

utility in question can be examined in depth. For many utilities, DCF analysis can fix investors' expected rates of return within reasonable confidence limits.

Nevertheless, there are grounds for broadening the sample where feasible. The most notable example to date is Myron Gordon's econometric model developed for the FCC hearings on A.T.& T.* Gordon's model is not inconsistent with the DCF approach; it is an adaptation (essentially of Eq. (3)) for statistical purposes.

The so-called capital asset pricing model,** which relates equilibrium expected rates of return to securities' risk characteristics, will probably be used for future econometric studies of utilities' capital costs.

Objections to Use of Market Data in Regulatory Proceedings

There are two possible reasons for objecting to the use of the shareholders' opportunity costs in regulatory proceedings. The first is that the cost of capital cannot be estimated with sufficient accuracy to support reasoned judgment by regulators. This objection can only be answered by experience.

The second objection is that data derived from stock market behavior is inappropriate for regulatory proceedings because of the market's essential irrationality or because of the alleged difficulty in

* FCC Docket 16258, 1966.

** See Sharpe, op. cit., esp. Ch. 5-7, for a summary.

dealing with estimates of an infinite dividend stream. These points require an immediate answer.

Speculation and randomness. -- Some find it difficult to rest regulatory proceedings on something so changeable as stock market behavior. A FPC examiner has stated that "There is no evidence to support the basic assumption that market prices (and therefore rational non-ephemeral costs of capital) are mathematically related to an ascertainable flow of long-term benefits -- cash or otherwise."* In support of this statement the examiner cites Gerald M. Loeb:**

Market values are fixed only in part by balance sheets and income statements; much more by the hopes and fears of humanity; by greed, ambition, acts of God, invention, financial stress and strain, weather, discovery, fashion, and numberless other causes impossible to be listed without omission.

Loeb is correct; but the examiner is wrong in inferring from Loeb's statement that the market is in some sense irrational and therefore not suitable for consideration in a regulatory proceeding. In fact, there is evidence to the contrary which I shall try to summarize.

Language. -- First, semantic difficulties must be recognized. An economist will describe the market process as the trade-off of risk and expected return; others might say that investors are torn between fear and greed. The latter description sounds less rational.

Rationality, income statements and balance sheets. -- Would "balance sheets and income statements" fix market values in a rational world? On

* FPC Docket RP69-39 (Cities Service Gas Co.). Presiding Examiner's Initial Decision (Phase I), issued April 23, 1970. p. 15.

** Gerald M. Loeb, The Battle for Investment Survival (New York: Simon and Schuster, 1965), p. 14.

the contrary, a rational investor knows that income statements and balance sheets are often biased indicators of the value and profitability of currently held assets* and that they give little direct information about future price and dividend performance -- which is what the investor is interested in. Actual future performance is contingent on countless variables. The rational investor has to identify the most important of these and take them into account as best he can.

Uncertainty is a fact of life, a fact which happens to be more dramatically disrobed in the stock market than elsewhere. Capital flows to where expected returns are adequate to compensate for the risks. Regulatory agencies may as well accept this.

The alternative -- reliance on a comparable earnings measure -- is superficially attractive in that uncertainty is hidden behind "objective" accounting data. But the expectations that move investors are hidden as well.

The random walk theory. -- It is a fact that stock price changes are random. This is not proof that the market is irrational. On the contrary, economic theory predicts that the price behavior in a rational and efficiently functioning market will be random.**

* See below, pp. 32-39.

** This has been fully and clearly explained by Eugene Fama, "Random Walks in Stock Market Prices," Financial Analysts Journal, September-October, 1965. Actually, tomorrows expected price is somewhat more than today's; investors require a positive expected return in any period to compensate them for bearing risk. Strictly speaking, it is the deviations from this positive return that are randomly distributed.

The fact that stock price changes are predominantly random thus supports the belief that the market's overall operation is efficient and rational.*

Incidentally, the randomness of price movements indicates that there is little point in regulators' relying on averages of stock prices over time as a basis for estimating the current cost of capital. For example, suppose a utility's current earnings-price ratio is of interest. A more accurate estimate of "true" or "normal" earnings can usually be obtained by averaging, fitting trend lines, or by some other smoothing device. On the other hand, today's stock price is the best estimate of the current "normal" price. If it were not, then one could predict the direction of future stock price movements (i.e., toward "normal") and stock price changes could not be random. The point is that any trending or averaging of past prices would erroneously imply the existence of trends or cycles in price movements, and thus would make the calculated earnings-price ratio less meaningful.

To summarize, there is positive evidence, from the random walk theory and other sources,**that the overall operation of the stock market is basically efficient and rational. Some conclude otherwise for a

* See Eugene F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance, Vol. XXV (May 1970), 383-417.

** Ibid.

variety of erroneous reasons. Rationality is confused with predictability, for example. The existence of evidently irrational investors is assumed to imply that all investors are irrational. The market's occasional gross errors -- which we identify with hindsight -- are assumed to imply that investors were acting irrationally in light of what they knew at the time. There are other mistakes equally easy to fall into.

Estimating an Infinite Stream of Dividends

The "DCF method" has often been used in proposed applications of finance theory in regulatory proceedings. Taken literally, the use of any DCF formula to estimate shareholders' opportunity costs requires an estimate of dividends from here to infinity. Clearly, it is infinitely difficult to make a good estimate of dividends in the infinite future. Is this a drawback to the method?

There are several partial responses that mitigate the apparent difficulty.

1. We are dealing with an asset which for practical purposes has infinite maturity. This fact can be hidden, but not escaped.
2. However, the discounting process gives dividends to be received in the far future very little present value. It is pointless to argue about, say, whether dividends will grow at a 5 or 10 percent rate from 1990 to 1995.
3. We have seen that commissions relied upon earnings-price ratios extensively in the past, and still admit them as evidence. Since the use of these ratios implies a special case

of the DCF formula, it necessarily assumes a projection of earnings per share or dividends per share to infinity.

But there is also a more basic response. Application of any DCF method requires only an accurate assessment of investors' expectations about the future. The fact that expectations will always prove wrong in some degree is irrelevant.

Perhaps this distinction is subtle enough to bear repeating. The point is to assess expectations, not to forecast future stock returns. For example, suppose we had estimated a utility's cost of capital as 10 percent in mid-1969. This means that investors at that time expected 10 percent from purchase of that utility. Now, we observe that the actual return from mid-1969 to mid-1970 was, say, minus 20 percent. Does this establish that the cost of capital was incorrectly measured in 1969? No: it simply shows that investors' expectations were not met for that period. This is no surprise; we know investors will be disappointed roughly half the time and favorably surprised the other half; this follows from the definition of "expectation," assuming roughly symmetric probability distributions.

To repeat, uncertainty is intrinsic to financial analysis. DCF and related approaches estimate investors' expectations in order to deal with uncertainty in an intelligent way. They cannot be asked to eliminate uncertainty.

Summary

It will be helpful to summarize the paper up to this point:

1. There are deficiencies in current procedures, particularly in the comparable earnings standard used to set allowable

rates of return to equity. These deficiencies justify search for something better.

2. Finance theory suggests use of a cost of capital concept.

Broadly speaking its application requires two steps.

- a. Measurement -- that is a judgment of the expected rate of return offered by securities of given risk characteristics.
- b. Application -- which may require adjustment of investors' opportunity costs for transaction costs, the mix of debt and equity financing, etc.

3. The measurement of utilities' cost of capital can be based on the "DCF approach" and also on interest rates, ex post rates of return, earnings-price ratios, and econometric models.
4. It is perfectly proper to rely on stock market data for regulatory proceedings. The overall operation of the market appears rational and efficient.

Now the task is to apply the cost of capital concept to regulatory proceedings.

V. USING SHAREHOLDERS' OPPORTUNITY COSTS IN
REGULATORY PROCEEDINGS

The Straight-Forward Approach-Application to Book Value Rate Base

We turn first to a simple example. Imagine a utility with book assets (rate base) of \$100 per share. The utility is all-equity financed. Earnings per share are \$10, all paid out as dividends. Earnings per share are expected to remain constant indefinitely.

Under such conditions, the earnings-price ratio (or the dividend yield) will measure shareholders' opportunity costs correctly. (Remember this is a special case of the DCF method, and one of many ways to estimate the cost of capital.) Suppose we observe a current price of \$125. Then

$$R = \frac{EPS_1}{P_0} = \frac{D_1}{P_0} = \frac{10}{125} = .08.$$

How should the regulatory commission use this information? What I will call the "straight-forward approach" is to allow earnings of 8 percent on the usual book value rate base. The utilities' prices will be set at a level sufficient to yield profits of .08(100) or \$8.00 per share, given current costs and sales volume.

If investors consider the new earnings level permanent, the

utility's stock price will fall to \$100.

$$P_0 = \frac{EPS_1}{R} = \frac{8.00}{.08} = 100.$$

In other words, the straight-forward application, in this ideal case at least, will drive share price to book value per share. The stock sold at \$125 in the first place only because the firm was then earning, and was then expected to earn, somewhat more than the cost of capital.

The simple example has a real factual content. Most utilities have earned more than the cost of equity capital and consequently, their shares have sold and are selling for more than the book value. It has been argued, therefore, that application of the DCF theory would force share prices down to book value. Whether this is so, and, if so, whether it is an appropriate regulatory aim, are questions I defer for a moment. First it is necessary to respond to the contention that the "straight-forward" approach is, in Ezra Solomon's words, "inherently contradictory and inconsistent,"* because of the gap between the cost of equity capital and the book rate of return actually earned by utilities. Walter Morton has

*

Prepared testimony of Ezra Solomon, Texas Eastern Transmission Co., FPC Docket RP69-13, Transcript p. 1044.

come to a similar conclusion:*

What is wrong with [the cost of capital] is that whenever it is applied to a price above book it must produce a cost of capital below existing earnings rates and thus cause a fall in earnings and a fall in the price of the stock. It basically assumes therefore, that the investor who pays twice book is buying with the expectation that the [cost of capital] will be applied to book, that earnings will be cut in half and that the price of the stock will also decline drastically. This assumption is contrary to fact.

Any theory which postulates that investors paying above book with the expectation that earnings will be cut as described by regulatory action must assume either profound ignorance and ineptitude on the part of the investors, or a spirit of masochism which induces them to destroy their own capital.

Actually there is nothing inconsistent or illogical about the straight-forward approach unless it is assumed that investors' expectations (as observed in the process of measuring the cost of capital) should always be confirmed when regulatory commissions act.

Take the simple example just introduced. The cost of capital is 8 per cent both before and after the regulatory decision, so there can be no error or inconsistency in measurement. Rather, what happens is that the expectations investors hold before the regulatory decision turn out to be wrong in the event. But the regulatory commission is not bound to confirm investors' expectations. Therefore, the straight-forward approach is logically sound.

*

"Guides to a Fair Rate of Return, " p. 22.

One point must be admitted. If regulatory actions are so consistently unpredictable that assessing investors' expectations degenerates to a guessing game about the commission's whims then the measurement of shareholders' opportunity costs is made more difficult. The DCF method would not be useful, for example.* One would have to rely on other measurements of shareholders' opportunity costs such as more broadly-based econometric models. But in practice commission decisions are reasonably stable and consistent overtime. Basic changes in regulatory procedures do occur from time to time but hardly often enough to make commission action consistently unpredictable.

Further, a utility's long-run profitability is not simply dependent on what commissions do. As is shown below, there is enough flexibility in the regulatory process that managerial efficiency, market growth, trends in factor costs, etc., have an important impact. Predicting future profitability is not simply a matter of predicting regulators' behavior.

This discussion also illustrates the dangers in using the market value of a firm's assets (in particular, market value as measured by share price) as a basis for setting earnings levels, as has been im-

* For example, suppose the commission announces that it will use the straightforward approach along with the DCF method of measurement. Share price would fall, since investors would anticipate a lower allowed rate of return after the commission acts. On the other hand, if share price falls the commission may well over-estimate the cost of capital by assuming investors expect continued earnings of \$1.25. If investors, recognizing this, therefore expect that the regulators will misread their (investors') expectations . . . Clearly we have the beginnings of a very complicated game.

plicitly recommended by Irwin Friend and Myron Gordon among others.*

For instance, a market value rate base can amount to a commitment always to confirm investors' expectations. In the example, presented above, suppose the rate base is set at \$125, the observed market price per share, rather than \$100, the book value rate base. Then earnings allowed would be \$10 per share and share price would remain at \$125.

This point is explicitly recognized in the Hope Natural Gas Company case, the basic Supreme Court decision on rate of return regulation:**

The fixing of prices, like other applications of the police power, may reduce the value of the property which is being regulated. But the fact that the value is reduced, does not mean that the regulation is invalid It does, however, indicate that 'fair value' is the end product of the process of rate-making not the starting point The heart of the matter is that rates cannot be made to depend upon 'fair value' when the value of the going enterprise depends upon earnings under whatever rates may be anticipated.

Will Share Prices Be Forced to Book Value?

In our examples, straight-forward application of the DCF approach forced share price down to book value per share. This is generally true if the utility can actually be expected to earn the rate set for regulatory purposes. This is not a reasonable assumption.

* See Their 1966 testimony in the A.T.& T. hearings, FCC Docket 16258. In Friend's testimony, (Bell Exhibit 18), see p. 12. In Gordon's FCC Staff Exhibit 17), see pp. 5-6. Gordon states, "the criterion an agency should employ in setting the price of the product is that the rate of return the utility earns on investment will be high enough so that the desired investment and financing by the utility will not depress the price of its stock."

** 320 U.S. at p. 601.

The reason prices of utility stocks have exceeded book values may ^{more} be/due to the utilities' consistent ability to earn more than the nominal rate of return set by regulators, than it is to the regulators' setting a nominal rate above the cost of capital.

This can be illustrated by the case of Texas Eastern Transmission Company. The firm's rate settlement in 1965 was on the basis of an overall rate of return of less than 6.5 percent. If Texas Eastern had actually earned 6.5 percent overall in 1965 and subsequent years, then it would have achieved the rates of return on book equity indicated on the left-hand column of Table 2. The actual rates of return are shown at the right.

Although it is difficult to identify exact causes, the ability of utilities to earn more than is nominally allowed appears due to three factors.

Regulatory lag. -- The existence of a regulatory lag is necessary but not sufficient. That is, if prices were immediately lowered (raised) whenever a utility's realized return rose above (fell below) the allowed return, then the utility would always earn exactly the allowed return.

Favorable Cost Trends. -- The tendency in regulatory proceedings is to estimate future costs per unit of output on the basis of past costs and output. The likely future changes in cost and output levels are not taken into account systematically. If cost trends are favorable -- due to technological advances, for example, or to market growth when there are economies of scale -- then regulatory lag will allow utilities always to stay somewhat ahead of the game.

TABLE 2

Texas Eastern Transmission Company -- Actual Rates of Return on Equity
vs. Rates Implied by 6.5 per cent Overall Return.

<u>Year</u>	<u>Rates Implied by 6.5 per cent over- all Return</u>	<u>Actual Return</u>	<u>Difference</u>
1965	11.10	14.03	2.93
1966	10.65	14.44	3.79
1967	9.98	15.10	5.12
1968	9.38	16.25	5.87

Source: FPC Docket RP69-13 (Phase I), Initial Brief of Commission Staff.

Factors not under regulatory control. -- A number of factors not under direct regulatory control have contributed to high actual rates of return. Congress directed that the investment tax credit should be captured by utility investors, not passed on to consumers. There are certain sales made intra-state or to industrial customers which are not subject to Federal regulation.

The net effect of these factors has been to substantially increase the profitability of public utilities. The straightforward application of the cost of capital to a book value rate base will not in itself change this situation.

Mixing True and Accounting Rates of Return

Ezra Solomon has forcefully pointed out one major difficulty in current regulatory procedures.* As matters stand now, regulation is based on utilities' accounting or "book" rates of return. (That is, the ratio of reported earnings to rate base. The rate base is essentially the book value of the firm's assets.) The trouble is that book rates of return are often very poor measures of true economic rates of return. This is demonstrated below.

Solomon also alleges that, because book and true rates of return differ, the cost of capital (an estimated true rate) should not be used as a basis for the book rate of return set in regulatory proceedings.**

* "Alternative Rate of Return Concepts and Their Implications for Utility Regulation," Bell Journal of Economics and Management Science, 1 (Spring 1970), 65-81. See also Ezra Solomon and Jaime C. Laya, "Measurement of Company Profitability: Some Systematic Errors in the Accounting Rate of Return," in A. A. Robichek, ed. Financial Research and Management Decisions (N.Y.: Wiley, 1967).

** See "Alternative Rate of Return Concepts . . .," pp. 69-80. Also see his "Prepared Direct Testimony," in FPC Docket AR690, et.al. (Offshore Southern Louisiana Area Rate Proceeding), passim, esp. pp. 9, 15.

This issue requires careful examination.

The nature of the underlying problem can be easily illustrated.*

Table 3 shows a hypothetical project with a true rate of return of 10 percent over its six-year life (i.e., a 10 percent return on a DCF basis).

The following facts can be noted:

1. A firm composed of such projects which does not grow -- which at every point in time has one-sixth of its assets one year old, one-sixth two years old, etc. -- would report a 10.79 percent return on capital. Its true rate of return is 10 percent by definition. Further, although it's not immediately apparent from this example, this error increases as the life of the underlying assets increases. For a no-growth firm investing in twenty-year projects, also with a true rate of return of 10 percent, the book return would be 12.9 percent.
2. The error is exactly as shown only for assets yielding constant cash flows and depreciated on a straight-line basis. In general, the error is sensitive to both the pattern of cash flows over time and the depreciation policy chosen. Investment that is expensed (e.g., oil companies' exploration costs) also affects the "depreciation" pattern.
3. The error is strongly affected by the growth rate of the firm. Table 3 shows that the book return is low for new projects but high for old ones. Thus a rapidly growing firm, one composed

* The following paraphrases Solomon's work, cited above. See "Alternative Rate of Return Concepts . . . , " for example.

TABLE 3

The Basic Investment Project:
Net Income, Net Book Value, and Book-Yield

Year	Cash Flow	Depreciation (Straight-Line)	Net Income	Beginning of the Year Net Book Value	Project Book-Yield (%)
1	\$ 229.61	\$ 166.66	\$ 62.95	\$ 1000.00	6.30
2	229.61	166.66	62.95	833.33	7.55
3	229.61	166.66	62.95	666.67	9.44
4	229.61	166.66	62.95	500.00	12.59
5	229.61	166.66	62.95	333.33	18.89
6	<u>229.61</u>	<u>166.66</u>	<u>62.95</u>	166.67	37.77
	<u>\$1377.66</u>	<u>\$1000.00</u>	<u>\$377.66</u> ^a		

a

These do not add up because of rounding errors.

Source: Solomon and Laya, op. cit., p. 157.

predominantly of new projects, will report a lower book return than a stable or declining business, even if the true profitability of the two firms is the same. Further, the sensitivity of the book rate of return to growth will depend upon the time pattern of cash flows, depreciation policies, etc.

4. Inflation will complicate matters even further, since it will typically affect operating cash flows before it affects the book value of assets or depreciation charges.

Unfortunately, the exact relationship between true and book rates of return is very difficult to calculate except for certain simple cases. There is no manageable general formula. It is not difficult to recognize the direction of the error caused by growth, depreciation policies, etc., but very difficult to judge the error's extent.

Solomon concludes correctly that "(1) The rate of return in conventional book rate units is conceptually and numerically different from the rate of return in DCF units. (2) Two companies with similar DCF rates of return may well show widely differing book rates of return."*

This clearly poses a substantial problem for regulators, under current procedures where the book rate of return is the primary decision variable. How serious is this problem and what can be done about it?

A complete answer is impossible at this point, but a tentative answer does emerge on closer examination of the problem.

* "Alternative Rate of Return Concepts . . .," P. 78.

First, consider Table 4. It shows another six-year project. Its cash flows in each period cover depreciation plus 10 percent of the book value of the assets at the start of the period. The book rate of return is thus always 10 percent. The true rate of return is also 10 percent. A firm composed of any number of such projects, of any vintages, will also offer both true and reported book rates of return of 10 percent in every year of its life.

This could well be the result of regulation under current procedures, assuming an allowed rate of return of 10 percent. That is, if a regulatory commission decides to allow a return R , and adjusts the utilities' prices frequently enough that the utility always earns R on a book basis, then the utility will earn the same true return R .

It must be granted that regulation does not work this perfectly. There are lags and therefore some fluctuations in book returns, with unknown effects on true returns. Allowed rates of return change from time to time. Inflation is a factor. The likely effects of all these items probably cannot be assessed without building a relatively detailed simulation model.

Nevertheless, I think we can anticipate the likely results of such a simulation. The biases in the book return are due to the variation on individual assets' book returns over their life. The regulatory process diminishes the variation of returns over the life of the utilities' assets. Thus the extent of the variation is probably much less for utilities than for manufacturing companies or other unregulated firms.

TABLE 4

Another Hypothetical Project

Year	Book Value Beginning of Year	Profit at 10%	Book Value at End of Year Before With- drawal	Cash With- drawal at End of Year	Ending Book Value	Reduction in the Project's Book Value
1	\$1000.00	\$100.00	\$1100.00	\$229.61	\$870.39	\$129.61
2	870.39	87.04	957.43	229.61	727.82	142.57
3	727.82	72.78	800.61	229.61	571.00	156.83
4	571.00	57.10	628.10	229.61	398.50	172.51
5	398.50	39.85	438.35	229.61	208.74	186.76
6	208.74	<u>20.87</u> <u>\$377.66</u>	229.61	<u>229.61</u> <u>\$1377.66</u>	0	<u>208.74</u> <u>\$1000.00</u>

Source: Solomon and Laya, op. cit., p. 155.

Utilities are the class of firms least sensitive to the kinds of errors that Solomon has uncovered.

Assume then, that there is some bias in utilities' book rates of return -- probably not large, although we cannot be absolutely sure. How should this affect regulatory decisions?

Comparable earnings method. -- The comparable earnings method has an apparent advantage of consistency, in the sense that a utility's allowed book rate of return is weighed against the book returns of other firms. In light of the errors in the book rate, however, the rule calls for comparison with unregulated firms whose book rate is subject to biases similar to those of the utility being regulated.

This only aggravates the problems in using the comparable earnings rule. The only firms likely to satisfy this condition are other utilities. But their returns reflect past regulation and thus do not provide an independent standard. The alternative is to use the book return on unregulated firms, which are riskier and will report book returns subject to different and probably more severe biases. A number of rather complicated adjustments are called for if unregulated firms are to provide the standard.

In short, we have the following problem. Let b_i = the current book rate of return of firm i ; r_i = the true rate of return earned by firm i ; and $b_i = r_i + e_i$. Let x be the utility under regulation and y some unregulated firm. Suppose y has risk characteristics similar to x 's (which is unlikely) and operates in a perfectly competitive industry (which may or may not be true). If b_x is regulated to equal b_y , then the true return of utility x will depend on

e_x and e_y :

$$b_x = b_y$$

$$r_x + e_x = r_y + e_y$$

$$r_x = r_y + e_y - e_x. \quad (5)$$

Thus the desired result (that $r_x = r_y$) follows only if e_x and e_y "balance out". It seems unlikely that this could happen, or that regulators could recognize it if it did happen. * The likely case is that e_y will be both larger in absolute value and less predictable than e_x . The biases of book returns are likely to be much more serious and difficult to identify for unregulated firms than for utilities.

DCF rates of return. -- Now consider the straight-forward application of cost of capital as an alternative to the comparable earnings standard. If we can observe the cost of capital for utility x then the desired result of regulation is that $r_x = R_x$, where R_x is the cost of capital. Thus b_x should be set so that

$$b_x = R_x + e_x. \quad (6)$$

*

Particularly since a relatively broad sample of unregulated firms would probably be used as a standard. The error term e_y could vary substantially across the sample.

The problem Solomon identified is clearly still with us in the guise of e_x . But is actually less severe than under comparable earnings method. There is reason to believe that e_x is relatively small. Further, there is hope that simulation models can be built to generate reasonable estimates of its likely extent. In any case, recognizing and adjusting for e_x seems in the long run a much more manageable problem than recognizing and adjusting for the difference of e_y and e_x .

To conclude, neither the comparable earnings method nor the straightforward application of cost of capital to the book value rate base holds up perfectly in the face of the infirmities of the book rate of return as a measure of true profitability. But the cost of capital holds up better. This is true even though it is at first glance inconsistent, in the sense that it requires comparison of the true rate of return (R) to the book rate of return being regulated.

Summary

In this section I have presented a straightforward application of the cost of capital concept to rate of return regulation. This approach has been proposed in several proceedings.* I have answered the major

* Examples are prepared testimony of S. C. Myers, Texas Eastern Transmission Co. FPC Docket RP69-13; testimony of David A. Kosh, New England Telephone and Telegraph Company, Rhode Island Public Utilities Commission Docket 1024; Testimony of Bruce A. Hurt, Manufacturers Light and Heat Company, et al, FPC Docket RP69-16.

objections that have arisen, namely:

1. That the approach is logically inconsistent because investors' expectations cannot be realized unless stock price equals book value per share.
2. That stock price would necessarily be forced to book value per share if the straightforward approach were used.
3. That the straightforward approach should be disqualified because it relates utilities' book returns to an estimate of the true rate of return expected by investors.

The positive case for use of the cost of capital concept is taken up in the next section.

VI. FINANCE THEORY AND THE AIMS OF REGULATION

We have seen the dangers in regulatory proceedings which require regulators simply to confirm existing profit levels or investors' expectations of future profit levels. But this does not establish what the aim of rate of return regulation should be. What does finance theory tell us here? Should regulatory commissions act to force share prices down to book value per share, for example?

To some extent this is a matter requiring value judgements. An investor who purchases shares of Utility X at \$125 in good faith will feel cheated by a sudden change in regulatory procedures which hands him a \$25 capital loss. On the other hand, the cost of keeping the investor whole is borne by the consumer. Whether we favor the investor or the consumer is a question that finance itself cannot answer.

Economic Efficiency and the Cost of Capital

There is one economic principle which regulators should adhere to.

If use of one factor of production is subsidized then the utility will use more of this factor than it should. So long as the utility can expect to earn more than the cost of capital on new assets it will invest more than it would under perfect com-

petition for any given level of capacity. There will be an incentive to "build up the rate base" at the expense of under-utilization of assets or inefficient use of other factors of production.*

This suggests the principle, that regulation should assure that the expected rate of return on desired new utility investment is equal to the cost of capital.

This principle can also be based on fairness. An opportunity to invest in a project offering more than the cost of capital generates a capital gain as soon as the market recognizes the opportunity. This is a windfall gain, since it is realized ex ante, not as a reward for waiting or bearing risk.

It is important to remember that this is an ex ante concept. The principle is not violated if in the event the return on assets is more or less than the cost of capital. (Perfect competition does not require that expectations be realized for individual assets, or even on the average over any given period of time.)

Evaluation of the Straight-Forward Approach

What I have called the straight-forward approach -- i.e., an allowed rate of return equal to the cost of capital, applied to the usual book value rate base -- is consistent with the principle just stated under the following conditions.**

* See H. Averch and L. L. Johnson, "Behavior of the Firm Under Regulatory Constraint," American Economic Review, LII (December, 1969), 1052-69.

** The principle would also be satisfied if, by chance, errors in measuring the cost of capital were just offset via the "correct" regulatory lag, or if the conditions were violated in some other mutually offsetting way.

1. At any point in time the cost of capital is expected to remain constant. In other words, the condition is not that the cost of capital is constant (i.e., certain to remain at its current level) but that changes in it cannot be recognized before the fact.
2. Either that regulatory lag is negligible or that its effect will not be to consistently or predictably favor either utilities or consumers.
3. Shareholders' opportunity costs are currently measured.

The effect of these three conditions is that the expected cash flows to any additional asset would follow the pattern shown by Table 4. The expected book and true rates of return would be equal, and both would be equal to the current cost of capital.

Of these three conditions, the second is not true under current procedures, but the first could probably be accepted as a rule of thumb. Whether the third is true will have to be proved by experience.

It is true that if the straight-forward approach is applied in such a way as to maintain the principle stated, then price will be forced to book value after every rate of return proceeding. Shareholders will expect to earn the cost of capital (assuming the regulators have measured it correctly) multiplied by the book value rate base. Therefore, utility shares will be priced at book value.

* Although not necessarily between proceedings, if there is a regulatory lag. Even in this case, however, market will tend to equal book value on the average.

Allocation of Risk-Bearing. -- The sort of uncertainties facing investors under this plan will depend on whether there is a regulatory lag. Suppose first that there is no lag. Then the uncertainties are:

1. That the cost of capital may change in the future.
2. That regulators may not measure the cost of capital accurately.
3. That demand and cost conditions will be such that there is no price for the utility's product sufficient to allow the utility to earn its cost of capital.

If these items can be ignored, or if they represent fully diversifiable or insurable risks, then the utility's stock will be effectively a risk-free investment and its cost of capital the risk-free interest rate.* This is not to say that the utility's assets are risk free, but that these risks are borne by consumers.

When there is a regulatory lag, there is another source of uncertainty:

4. That the utility may earn more or less than expected during the period of the regulatory lag.

This is not likely to be a wholly diversifiable risk. Given the existence of regulatory lag, the cost of capital will be above risk-free rates.

* A necessary requirement is, for example, that regulators' mistakes in estimating the cost of capital are uncorrelated with returns on other assets. I find it hard to decide whether this is a reasonable assumption. The errors may reflect political considerations, for example, which can be dependent on general economic conditions. On the other hand, there is less room or excuse for error as the cost of capital approaches the risk-free rate.

Current Regulatory Procedures. -- The discussion thus far provides some insight into current regulatory procedures, to the extent that we can imagine how they would be applied to an all-equity firm.

1. The evident ability of many or most utilities to earn more than their cost of capital indicates that current procedures do not maintain the principle stated, that the expected rate of return on new utility investment be equal to the cost of capital.
2. Current procedures are like the straightforward approach in that risks associated with demand and operating or factor costs are borne by consumers, except in the short run during the interval between rate proceedings. (At least this is the stated principle; there may be implicit adjustments to it in practice).

Alternative Approaches: Regulation Ex Ante

One very important point is that the principle of equality between expected returns on utility investments and utilities' costs of capital can be satisfied under a variety of arrangements for allocating risk between consumers and investors (and for that matter, taxpayers).

To illustrate, consider Utility X again. It is earning 10 percent on a rate base of \$100 per share. Its cost of capital is 8 percent. The straight-forward approach would reduce earnings on existing assets to 8 percent of their book value.

But the basic principle requires only that utility x's new investment offer an expected return of 8 percent. The principle does not require

that rates be cut to assure an 8 percent return on existing assets.

We can imagine a regulatory commission which sets rates only ex ante, with the understanding that actual returns may exceed or fall short of expectation according to chance events and management's skill in reacting to them.*

If this idea of ex ante regulation were taken to its logical conclusion and applied without compromise, the resulting regulatory system would operate something like this. Let

I_t = Gross investment of a utility in period t ;

R_t = Cost of capital measured at t (shareholders' opportunity cost), and

C_{tj} = Expected incremental operating costs due to I_t ; $j=1, 2, \dots, H$.

The incremental expected revenue requirements over the life of the investment ($j=1, 2, \dots, H$) are calculated as

$$REV_{tj} = C_{tj} + R_t(I_t - Z_{tj}),$$

Where Z_{tj} is the depreciation to be accumulated on I_t when the asset is j periods old.

Suppose that REV_{tj} is determined at time t , when the investment

* Of course, the hands off attitude with regard to ex post deviations from expected returns depends somewhat on the source of the deviations. A regulatory body might be willing to let stand deviations due to particularly good or bad management. But it would not be willing to accept high returns achieved by a utility which took advantage of its monopoly powers to reduce service levels.

is made, and not changed thereafter even if costs turn out to be higher or lower than expected. That is, revenues are regulated on a year-to-year basis according to the implicit contracts established by the past investment decisions of the utility. Then the utility's aggregate revenue requirements at any time J are

$$REV_J = \sum_{t=J-H}^J REV_{tj}$$

This rule, which I will call "pure ex ante regulation," has the interesting feature that all uncertainty as to an asset's operating costs are borne by investors once the assets are in place. This would increase utilities' costs of capital. The rule also has the clear advantages that:

1. Each period's investment will offer an expected rate of return equal to the cost of capital.
2. The utility's accounting rate of return is not the instrument of regulation. Thus any possible biases in accounting rates of return are irrelevant.
3. There is maximum incentive to improve operating efficiency once assets are in place.

Evaluation of Alternative Approaches

The final choice between (1) the "straight-forward approach," (2) the current regulatory framework, (3) pure ex ante regulation, and (4) intermediate methods, cannot be made at this time. More study is needed for a variety of reasons.

First, there are obvious practical problems in changing regulatory strategy. With respect to the "pure" ex ante method, for example, one would have to consider:

1. Whether the procedure is legal or would require new legislation.
2. How difficult the procedure would be to administer.
3. How expected future costs C_t are to be estimated. Pure ex ante regulation provides management with maximum incentive to lie about future costs.
4. Whether the cost of capital is to be real or nominal rate of return (i.e., how the costs and risks of inflation are to be allocated).

Second, the economic theory as to the best allocation of the risk associated with utilities' operations has not been studied carefully enough. I will offer a conjecture about the results of such a study, however. The relevant principle seems to be that risks should be borne by those economic units most specialized in this function. This means investors rather than consumers. Capital markets afford a wide variety of alternatives for diversification and for tailoring portfolios to particular risk preferences. Thus, an initial and very brief examination of the question seems to indicate that consumers should be insulated from the risks of utility operations and that this would increase welfare, even though the utilities' costs of capital would increase.

Third, the likely behavior of a utility under ex ante regulation or other alternatives to current procedures would have to be closely

examined to see whether financial behavior would really approximate perfect competition or whether there are ways to "beat the system."

Several broader issues that are also involved in the choice of an "optimal" regulatory strategy are noted at the end of the paper.

VII. REGULATING THE OVERALL RATE OF RETURN

Implications of Finance Theory

At this point we can drop the assumption of all-equity financing and consider how a mix of debt and equity financing alters the questions and conclusions just stated.

Measurement. -- Suppose we begin with the utility that is all-equity financed, with a cost of capital R_0 . If the utility revises its capital structure to include some debt, the cost of equity capital, k , will rise above R_0 because financial leverage makes the firm's stock riskier. The interest rate, i , on the firm's borrowing will be less than R_0 . Figure 1 shows how k and i vary as a function of financial leverage. It should be intuitively clear that the utility's overall cost of capital, R , can be measured as some sort of weighted average of k and i .

To get an exact measurement of R , given k and i , we can apply the same logic used to develop the cost of capital concept for the case of all-equity financing. Regardless of the degree of financial leverage, we can still consider investment in a portfolio approximating the risk characteristics of the utility's stock when it was all-equity financed. We could obtain such a portfolio by simply purchasing equal percentages of the outstanding amounts of each of the utility's financing instruments. Thus, suppose the utility had \$100 million debt outstanding (market value) and outstanding stock with an aggregate market value of \$150 million. Then a portfolio 40 percent invested in the

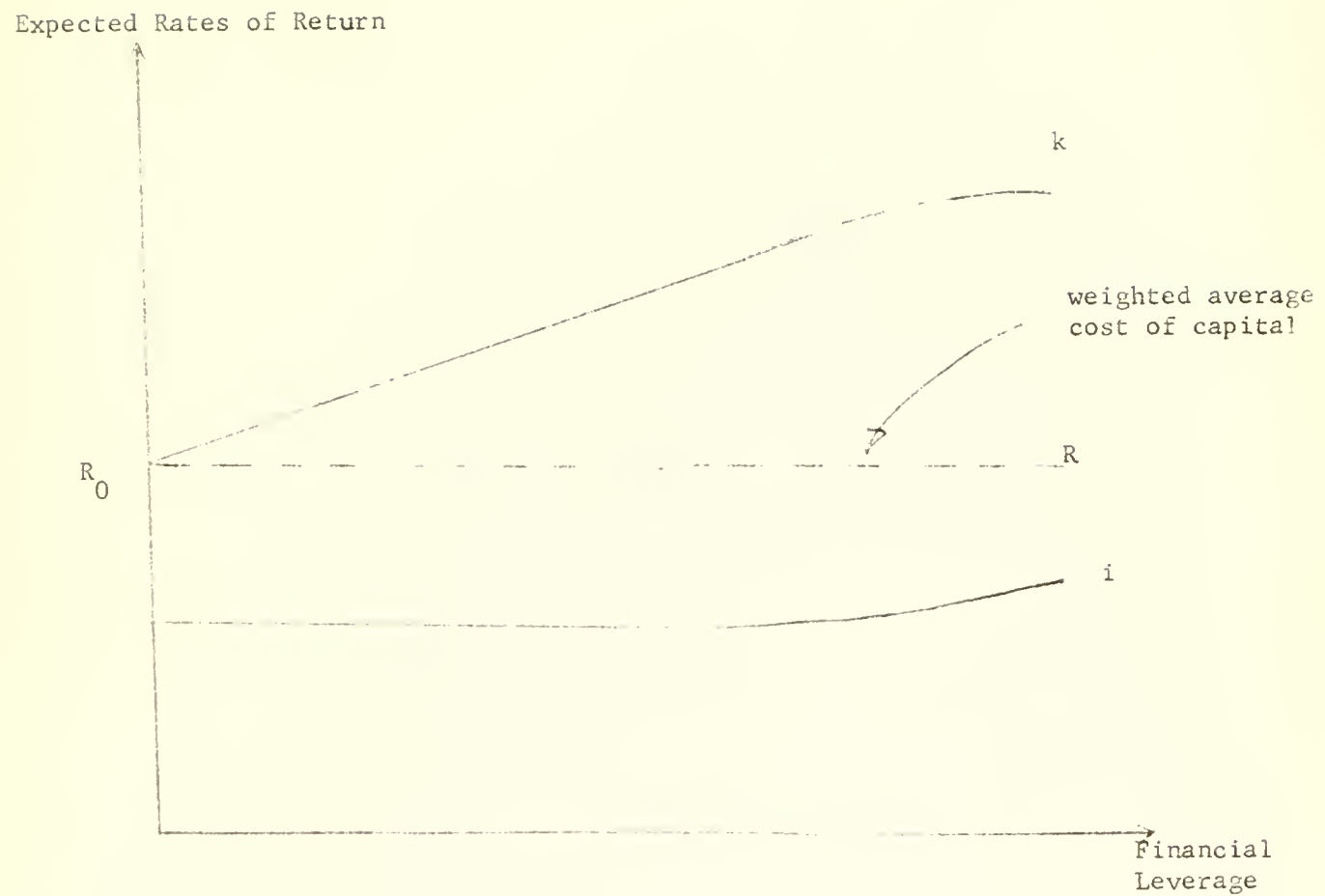


FIG. 1.

Effects of financial leverage on costs of debt and equity financing and the weighted average cost of capital.

utility's bonds and 60 percent in its stock would offer approximately the same risk characteristics as the firm's original shares.

We can consider shareholders' opportunity costs relative to such a portfolio. The portfolio falls in a class of equivalent-risk securities and portfolios. If the going expected rate of return for this class is R , then the utility's stock price will adjust so that the portfolio of the utility's stocks and bonds will likewise offer an expected return R . This rate R is the appropriate hurdle rate for the utility's new investment, providing that the investment's financing does not change the firm's capital structure, and that the risk class of the firm's underlying assets is unchanged by the new investment.

Assuming that the firm's capital structure is expected to remain constant, then R can be measured by*

$$R = i \frac{D}{V} + k \frac{E}{V}, \quad (6)$$

Where: i = current average yield to maturity of the firm's outstanding debt,
 k = expected rate of return offered by the firm's stock,
 D = market value of the firm's outstanding debt,
 E = aggregate market value of outstanding stock, and
 $V = D + E$.

R is simply the expected return on the hypothetical portfolio just dis-

* The formula is not appropriate when the firm's capital structure is expected to change. If change is expected the appropriate overall cost of capital cannot be determined without more specific information about how it depends on leverage. This problem is beyond the scope of this paper. The fact that R is drawn as a horizontal dashed line in Fig. 1 has no particular significance.

cussed. For example, consider a firm with \$100 million of debt outstanding and \$150 million of equity (market value). Its current cost of borrowing is 8 percent and its current cost of equity capital 11.33 percent. Then the weighted average cost of capital is 10 percent.

$$R = .08 \frac{100}{250} + .1133 \frac{150}{250} = .10.$$

Of the variables used to compute the weighted average cost of capital, only k is not directly observable. It must be estimated by the same means described above for the all-equity case -- the DCF method, earnings-price ratios, econometric models, or what have you.

Thus the computation of a weighted average cost of capital involves no additional problems of measurement, assuming debt-equity ratios are not expected to change.

Application. -- With an overall cost of capital R to work with, there is no difficulty in principle in applying it to the firm's overall rate base in exactly the same way as discussed previously. Either a straight-forward approach, ex ante regulation, or some intermediate rule can be used. Since all of the previous discussion applies there is no sense repeating it.

Problems With Current Regulatory Procedures

However, there are two additional problems associated with current regulatory procedures. The overall return allowed in practice is also a weighted average of debt and equity costs. But the computation differs from Eq. (6) in two important respects.

Embedded costs of debt. -- The debt cost now relied upon by regulators is not the current cost of borrowing but the original or "embedded" cost of the utility's currently outstanding debt. There can be substantial differences between current and embedded costs when interest rates rise or fall over time. In 1970, current borrowing costs are two to three percent above embedded costs.

If there is no regulatory lag, the use of embedded cost is consistent with the principle that utilities ought to expect to earn the cost of capital on new investment. If utilities could change their rates automatically anytime their embedded cost of debt changed, then the rate of return earned on new investment would always reflect the marginal cost of any debt financing associated with the investment.

But there is a lag. Thus, if interest costs are rising, utilities' overall allowed returns on new investment will tend to be less than the cost of capital, other things the same. The converse result follows when rates fall.

There is a reason to believe that the use of embedded debt cost does not lead to serious errors, however. The lag is two or three years at most, which is perhaps a tenth of the life of utility assets. Moreover, the lag is not mandatory. Utilities can, and do, file for rate

increases any time the combination of regulatory lag and the embedded cost rule is damaging.

The embedded cost concept is probably more important as a minor example of ex ante regulation.

Use of book weights in cost of capital computations. -- The fact that the cost of capital is applied to a book value rate base does not mean that book value weights should be used in measuring it. Market values rates should be used, as they are in Eq. (6). Regulatory commissions, however, use the proportions of debt and equity shown on the firm's balance sheets.

The effect of the use of book weights will be to understate (overstate) the true cost of capital to the extent that

1. Interest rates are rising (falling).
2. The utility's stock is selling at prices in excess of (below) book value.

Consider the following example, which roughly corresponds to conditions in early 1970.

1. Interest rates have increased to the extent that the market value of a utility's outstanding debt has fallen to 80 percent of the debt's par value. Let the book value be \$125 million and the market value \$100 million.
2. The utility's shares are selling at 1.5 times book. Let book value be \$100 million.

Then if we recompute the overall cost of capital for the costs of debt

and equity used in the example illustrating Eq. (6)*, the result is:

$$R = .08 \frac{125}{225} + .113 \frac{100}{225} = .0947,$$

which understates the true cost of capital by about one half percent.

The use of book weights is clearly illogical. Other things the same, an incorrect estimate of the cost of capital defeats the principle that a utility should expect to earn the cost of capital on new investment. About the best that can be said for it is that it tends to offset any errors due to regulatory lag. If a firm can consistently earn more than the cost of capital due to regulatory lag then its stock price will exceed book value per share and it will therefore find its cost of capital underestimated by regulatory commissions. This underestimate will tend to drive its stock price down.

Overall evaluation. -- With respect to equity financing only, existing procedures are similar in framework to the straightforward application of the cost of capital concept. As is noted above, regulation is basically ex post, except for the period between proceedings. At each proceeding the allowed rate of return on all capital is set at a currently appropriate level. Existing procedures differ from the straightforward application in the way the appropriate rate is measured, and in the fact that investors apparently expect utilities to earn more than the

* Page 54 above.

rate regulators supposedly allow -- more, in fact, than the true cost of capital in the sense of investors' opportunity costs.

When debt and equity capital are considered together, we have an oddly mixed system. The embedded debt concept is more appropriate to ex ante regulation, since current debt costs are taken into account only with respect to current debt issues. In short, we have a system which uses book weights to combine current equity costs. Further research is needed to determine the exact properties and consequences of such a system.

VIII. SUMMARY AND CONCLUSIONSummary

The major points made in this paper can be summarized as follows.

1. There are problems with current regulatory procedures, particularly the "comparable earnings" method for estimating the allowable rate of return on equity capital.
2. Finance theory offers an alternative -- the cost of capital concept, which is based on currently anticipated returns on securities.
3. Use of the cost of capital requires two steps, each with its special problems:
 - a) Measurement.
 - b) Application to regulatory problems.
4. Estimation is ultimately a matter of judgment, but a variety of measurement approaches can be useful, including the "DCF method" and econometric models.
5. The various objections to use of the DCF method or to relying on data from an "irrational" stock market are unfounded. The DCF method is sound and the evidence indicates that the stock market is basically rational and efficient.
6. There have also been objections to straight-forward applications of the cost of capital in a regulatory context -- for example, the alleged logical inconsistency in applying a rate of return

derived from market data to a book value rate base, or the practical difficulty of relating book rates of return to true rates. There are no logical inconsistencies. The practical problems are not fatal -- in fact, they are less serious for the straight-forward approach employing the cost of capital than for the comparable earnings method.

7. The positive case for use of the cost of capital stems from the principle that utilities ought to expect to earn the cost of capital on new investment. This is a standard of equity and of economic efficiency.
8. Actually, there are several possible regulatory frameworks which employ the cost of capital and which maintain this principle. Some would require substantial changes. For example, regulation of rate of return on new investment might be accomplished entirely ex ante. This would lead to a different cost of capital due to a different, and possibly superior, allocation of risk bearing between consumers and investors. Such alternative procedures deserve careful research.
9. The cost of capital can be applied in a straight-forward way within current regulatory procedures. This would improve regulation by bringing the principle cited (in point 7 above) closer to realization than is possible by using the comparable earnings method. Full adherence to the principle will require, however:

- a) Use of market value weights in computing overall rates of return.
- b) Reduction in regulatory lag or its effects.
- c) Measuring debt costs on a current basis.

Conclusions -- Necessary Further Work

This is an open-ended paper -- perhaps some will say loose-ended. The problem lies not in reviewing current regulatory procedures or resolving the controversies associated with recent attempts to apply financial theory. These things have been done. The difficulty is that systematic application of finance theory reveals an embarrassment of alternatives for regulatory procedures, even under the somewhat restrictive assumptions maintained in this paper. For example, any regulatory strategy allocates risk among consumers and investors, and it is not clear at this point which allocation is best.

The open or loose ends fall into three categories. Further work is needed in each.

Specific problems related to current procedures. -- Space and time limitations prevented an exhaustive and fully documented treatment of current procedures and associated controversies. The reasons why utilities seem to benefit from regulatory lag are not definitively stated, for example. Nor is it clearly established that the difference between a utility's book and true rates of return is smaller and more easily predictable than for industrial firms.

Also, the argument portrays current procedures too simply. Regulators do not rely solely on the comparable earnings method or original cost rate bases., for example.

Finally, the analysis should be expanded to take account of inflation and changing debt-equity ratios.

Evaluating Alternative Regulatory Procedures. -- The number of conceivable alternatives to current procedures is very large. The practical and theoretical problems involved in identifying the "optimal" procedures have already been discussed (p. 50).

Effects of Rate of Return Regulation on Output and Investment. -- The analysis in this paper applies to any given level of output and investment. But the rate of return allowed a utility affects the price of its product and thus demand and output. Demand affects investment. The amount and type of investment responds to the rate of return allowed and to the overall regulatory framework.

There is a tradition of ignoring these interrelationships in rate of return proceedings as I have done in this paper. But a final analysis must recognize them without discarding the insights which finance provides.

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